

What is claimed is:

1. A clamp, comprising:

a handle assembly;

a gripping assembly having a pair of jaws that can be opened and closed to grip an element; and

a shaft assembly having:

a flexible shaft having a proximal end that is coupled to the handle assembly and a distal end that is coupled to the gripping assembly, the flexible shaft defining a bore and comprising a plurality of alternating first beads and second beads, each of the first and second beads having an outer surface;

wherein each of the second beads has a larger inner diameter than each of the first beads;

wherein each of the second beads is supported on the outer surface of two adjacent first beads; and

a cable which extends through the bore of the flexible shaft, the cable having a proximal end that is operatively coupled to the handle assembly and a distal end that is operatively coupled to the gripping assembly.

2. The clamp of claim 1, wherein each of the first beads has a three-dimensional convex torus configuration.

3. The clamp of claim 2, wherein each of the second beads has a three-dimensional convex torus configuration.

4. The clamp of claim 1, further including a rigid element that can be placed in a first position where the rigid element supports the shaft in a manner where the shaft cannot be bent, and in a second position where the shaft can be bent.

5. The clamp of claim 1, wherein each of the second beads has a larger outer diameter than each of the first beads.

6. The clamp of claim 1, wherein each of the second beads has a smaller outer diameter than each of the first beads.

7. The clamp of claim 1, wherein each of the second beads has the same outer diameter as each of the first beads.

5 8. The clamp of claim 1, wherein each of the second beads contacts the outer surface of two adjacent first beads along a line contact.

9. A clamp comprising:  
a gripping assembly having a pair of jaws that can be opened and closed to  
10 grip an element;  
a handle assembly having a ratchet assembly that locks the pair of jaws in a closed position; and  
a shaft assembly having:  
a flexible shaft having a proximal end that is operatively coupled to the  
15 handle assembly and a distal end that is operatively coupled to the gripping assembly; and  
a rigid element that can be placed in a first position where the rigid element supports the shaft in a manner where the shaft cannot be bent, and in a second position where the shaft can be bent.

20 10. The clamp of claim 9, wherein the handle assembly includes a first handle piece and a second handle piece, and the ratchet assembly includes:  
a ratchet rack pivotally coupled to the first and second handle pieces, the ratchet rack having a plurality of teeth; and  
25 a ratchet that is normally biased towards the ratchet rack, the ratchet having a tooth that is adapted to engage one of the plurality of teeth on the ratchet rack.

11. The clamp of claim 10, wherein the ratchet is pivotally coupled to the second handle piece.

30 12. The clamp of claim 10, wherein the ratchet has a portion that is pushed to pivot the ratchet away from the ratchet rack to release the engagement of the tooth of the ratchet with the one of the plurality of teeth on the ratchet rack.

13. The clamp of claim 12, wherein the ratchet assembly further includes at least one release button that is coupled to the ratchet to pivot the ratchet away from the ratchet rack to release the engagement of the tooth of the ratchet with the one of the plurality of teeth on the ratchet rack.

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14. The clamp of claim 10, wherein the ratchet assembly further includes at least one release button that is coupled to the ratchet to pivot the ratchet away from the ratchet rack to release the engagement of the tooth of the ratchet with the one of the plurality of teeth on the ratchet rack.

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15. The clamp of claim 12, wherein the portion is a handle that is provided at one end of the ratchet.

16. The clamp of claim 14, wherein the ratchet assembly further includes a rod which is coupled to the ratchet and the at least one release button, and wherein pivoting of the at least one release button causes the rod to experience longitudinal motion which pivots the ratchet.

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17. The clamp of claim 14, wherein the at least one release button comprises two release buttons.

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18. The clamp of claim 14, wherein the at least one release button is pivotally coupled to the second handle piece.

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19. The clamp of claim 10, wherein the ratchet assembly further includes a spring that biases the ratchet towards the ratchet rack.

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20. The clamp of claim 9, further including a first release mechanism and a second release mechanism, wherein the first and second release mechanisms are coupled to the ratchet assembly, and wherein the ratchet assembly can be disengaged by actuating: (i) the first release mechanism, or (ii) the second release mechanism, or (iii) both the first and second release mechanisms.

21. A clamp comprising:  
a handle assembly;  
a gripping assembly having a pair of jaws that can be opened and closed to grip an element;

5 a shaft assembly having:

a flexible shaft having a proximal end that is operatively coupled to the handle assembly and a distal end that is operatively coupled to the gripping assembly; and

10 a rigid element that can be placed in a first position where the rigid element supports the shaft in a manner where the shaft cannot be bent, and in a second position where the shaft can be bent; and

a lock assembly which locks the rigid element in the first position.

22. The clamp of claim 20, wherein the lock assembly locks the rigid  
15 element to the gripping assembly.

23. The clamp of claim 22, wherein the rigid element is a movable covering that is coaxial to the shaft, and wherein the covering completely covers the shaft in the first position and exposes a portion of the shaft in the second position.

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24. The clamp of claim 23, wherein the covering has a distal end, and the lock assembly includes an alignment mechanism that aligns the distal end of the covering with the gripping assembly when the covering is in the first position.

25. The clamp of claim 23, wherein the gripping assembly includes a jaw base, and the lock assembly includes:

a helix cylinder that is secured to the jaw base;

a lock housing that is secured to the covering; and

means for slidably engaging the helix cylinder and the lock housing.

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26. The clamp of claim 25, wherein the lock housing has a bore which removably retains a portion of the helix cylinder.

27. The clamp of claim 25, wherein the engaging means includes a dimple on the helix cylinder and a biased ball positioned in the lock housing, the biased ball being fitted inside the dimple when the helix cylinder is secured to the lock housing.

5        28. The clamp of claim 25, wherein the distal end of the shaft is secured to the helix cylinder.

29. The clamp of claim 25, wherein the lock housing has a bore, and the shaft extends through the bore of the lock housing.

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30. The clamp of claim 28, further including a cable that extends through the shaft and the helix cylinder.

31. The clamp of claim 30, wherein the helix cylinder has a longitudinal bore, and further including a spring retained inside the longitudinal bore and surrounding a portion of the cable.

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32. The clamp of claim 30, wherein the cable has a distal end, and further including a cable holder that secures the distal end of the cable, the cable holder being operatively coupled to the helix cylinder.

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33. A clamp comprising:  
a handle assembly;  
a gripping assembly having a pair of jaws that can be opened and closed to grip an element;  
a shaft assembly having:  
a flexible shaft having a proximal end that is operatively coupled to the handle assembly and a distal end that is operatively coupled to the gripping assembly; and  
a movable covering coaxial to the shaft that can be placed in a first position where the covering exposes a portion of the shaft, and in a second position where the covering covers most of the shaft, the covering having a distal end; and

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an alignment mechanism that aligns the distal end of the covering with the gripping assembly when the covering is in the second position.

34. The clamp of claim 33, wherein the gripping assembly includes a jaw  
5 base, and the alignment mechanism includes:

a helix cylinder that is secured to the jaw base, the helix cylinder having a guide surface and a slot;

a housing that is secured to the covering, the housing having a pin that is adapted to travel along the guide surface and be retained in the slot.

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35. The clamp of claim 34, wherein the housing has a bore which removably retains a portion of the helix cylinder.

36. The clamp of claim 34, wherein the guide surface is helical.

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37. The clamp of claim 34, wherein the distal end of the shaft is secured to the helix cylinder.

38. The clamp of claim 34, wherein the housing has a bore, and the shaft extends through the bore of the housing.

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39. The clamp of claim 37, further including a cable that extends through the shaft and the helix cylinder.

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40. A clamp comprising:

a handle assembly;

a gripping assembly having a pair of removable jaws that can be opened and closed to grip an element; and

a shaft assembly having:

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a flexible shaft having a proximal end that is operatively coupled to the handle assembly and a distal end that is operatively coupled to the gripping assembly; and

a rigid element that can be placed in a first position where the rigid element supports the shaft in a manner where the shaft cannot be bent, and in a second position where the shaft can be bent.

41. The clamp of claim 40, wherein the pair of removable jaws includes a first jaw and a second jaw, wherein the gripping assembly further includes:  
a first jaw base having a first bore, with the first jaw removably retained in the  
5 first bore; and  
a second jaw base having a second bore, with the second jaw removably retained in the second bore.

42. A clamp comprising:  
10 a handle assembly;  
a gripping assembly having a pair of jaws that can be opened and closed to grip an element;  
a shaft assembly having:  
a flexible shaft having a proximal end that is operatively coupled to the  
15 handle assembly and a distal end that is operatively coupled to the gripping assembly;  
a plurality of telescoping tubes that are coaxial to the shaft, wherein the telescoping tubes are placed in a first position where the telescoping tubes expose a portion of the shaft, and in a second position where the telescoping  
20 tubes cover most of the shaft; and  
means for locking each telescoping tube in a fixed position with respect to an adjacent telescoping tube.

43. The clamp of claim 42, wherein the locking means includes a dimple  
25 provided on one telescoping tube and a locking tab provided on an adjacent telescoping tube.

44. A method of using a clamp during a surgical procedure, comprising:  
30 a. providing a clamp comprising:  
a handle assembly;  
a gripping assembly having a pair of jaws that can be opened and closed to grip an element; and  
a shaft assembly having:  
a flexible shaft having a proximal end that is operatively coupled to the

handle assembly and a distal end that is operatively coupled to the gripping assembly; and

a rigid element;

5       b.       positioning the rigid element in a first position where the rigid element supports the shaft in a manner where the shaft cannot be bent;

      c.       introducing the jaws into a surgical site via an opening that has a size which is smaller than a surgeon's hand; and

      d.       manipulating the jaws inside the surgical site solely by controlling the handle assembly that is positioned away from the surgical site.

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45.    The method of claim 44, further including:

      e.       closing the jaws inside the surgical site solely by controlling the handle assembly that is positioned away from the surgical site.

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46.    The method of claim 45, further including:

      f.       positioning the rigid element in a second position where the shaft can be bent.

47.    The method of claim 46, further including:

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      g.       moving the handle assembly away from the surgical site.

48.    A shaft for use with a clamp device, comprising:

      a plurality of alternating first beads and second beads, each of the first and second beads having an outer surface;

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      wherein each of the second beads has a larger inner diameter than each of the first beads; and

      wherein each of the second beads is supported on the outer surface of two adjacent first beads.

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49.    The shaft of claim 48, further including:

      a rigid element operatively coupled to the plurality of beads, the rigid element being placed in a first position where the rigid element supports the shaft in a manner where the shaft cannot be bent, and in a second position where the shaft can be bent.

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